Recent Researches in *Astelia* B. and S.

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[At the Auckland Meeting, 1937, of the Australian and New Zealand Association for the Advancement of Science, Miss L. M. Cranwell read a short paper by Professor Skottsberg under the above title. As his publications on *Astelia* are of great moment and may not be fully accessible to many New Zealand writers, I have extracted from them, as a preface to his paper, certain matters helping to elucidate his text and to give points essential for writers on the genus in New Zealand. May I add an expression of the appreciation of all southern botanists of the services he has rendered to phytogeography, and of the special significance of much of his work for us in New Zealand?
H. H. Allan.]

Key to the New Zealand Genera and Species.

Racemi inferiores (nisi panicula valde reducta) virgati, ramis 1–3 basalibus. Flores ♂ and ♀ structura haud multum dissimiles. Antherae ovoideae-elipsoideae, dorsifixae, in apice filiformi filamenti mobiles, mox caducae. Ovarium uniloculare placentis parietalibus vel triloculare placentis axilibus. Semina laevissima, lucida, pilis longis mucilaginosis haud arcte cincta. .. .. .. *Astelia.*

Racemi omnes simplices. Flores ♂ quam ♀ valde majores, tepalis longissimis tenuissimis. Antherae lineares sagittatae, basifixae, immobiles, persistentes. Ovarium triloculare, placentis in dissepimentorum parte interiore evolutis. Semina plerumque pilis mucilaginosis e funiculo ortis usque ad maturitatem cincta. *Collospermum.*

Astelia Banks et Solander, MSS. ex R. Brown.

1. (a) Ovarium uniloculare. Semina subteretia, vel teretia, funiculo incrassato. Subg. I. *Euastelia.* 2
   (b) Ovarium triloculare. Semina rotundato-angulata, funiculo minimo. 5
2. (a) Tepala omnino libera. Pistillodium majusculum. Semina ellipsoidea-pyriformia funiculo ± hamato. .. 3
   (b) Tepala breviter coalita. Pistillodium minimum. Semina ± pyriformia, interdum leviter curvata, funiculo flabellatim incrassato. 4
3. (a) Folia basi lanigera, ceterum squamoso-lanata vel pelliculo obtecta, non cylindracea nec apiculata. .. *linearis.*
   (b) Folia inferne parce pilosa, ceterum glaberrima; lamina carnosa, filiformi-cylindracea, apiculato-subulata. .. *subulata.*
4. (a) Nervuli transversi indistincti vel nulli. Tepala apiculata, exteriora ♂ 4–4, ♀ 2·5–3·5 mm. longa. .. *Solanderi.*
   (b) Nervuli transversi distinctiores. Tepala caudata, exteriora ♂ 5–6, ♀ 4–5 mm. longa. .. .. *trinervia.*
5. (a) Tepala breviter coalita. Subg. II. *Asteliopsis.* .. *Banksii.*
   (b) Tepala, praecipue in ♀, tubum campanulatum vel urceolatum baccam inferne arcte includens formantia. Subg. III. *Tricella.* 6
6. (a) Robustae foliis rigidis, lamina plerumque 2 cm. et ultra lata. Tubus florum ♀ 3–5 mm. altus. 7
   (b) Minus robustae, dense extensim caespitosae. Folia subcoriacea, haud supra 2 cm. lata. Tubus florum ♀ 1–2 mm. altus. .. .. *nivicola.*
7. (a) Nervorum lateralium duo quam ceteri paulum magis incrassati vel omnes subaequales. Panicula inter folia abscondita, ovoidea, 5–9 cm. longa, densiramea. .. *Petriei.*

(b) Lamina eximie tricostata. Panicula elongata, ♂ 10–40 cm. longa, ♀ brevior et magis contracta, ramis 4–5. .. 8

8. (a) Lamina 3–7 cm. vel ultra lata, costis lateralibus simplicibus. Panicula ♀ usque 30 cm. alta. .. .. *nervosa.*

(b) Lamina ± 2 cm. lata, costis lateralibus duplicibus. Panicula ♀ usque 15 cm. alta. .. .. .. *Cockayneі.*

Collospermum Skottsberg.

1. (a) Nana, foliis 10–30 cm. longis et 0·5–1 cm. latis. Inflorescentia simplex, spicatim racemosa. .. .. *spicatum.*

(b) Majusculae, foliis 0·5–1 m. et ultra longis, 1–3 cm. et ultra latis. Inflorescentia e racemo terminali et racemis lateralibus composita. 2

2. (a) Folia > 2 cm. lata. Seminum testa opaca, jugis irregulariter percursa, semper arillo glutinoso arte vestita. *hastatum.*

(b) Folia 1–1.5 cm. lata. Semina laevia, lucida, ad maturitatem ab arillo facile separanda. .. .. *microspermum.*

Remarks on the New Zealand Species.

Euastelia: Sect. Asteliella.

1. *A. linearis* Hook. f. Cheeseman, *Manual,* ed. 2, p. 314, Stewart Island, Auckland Islands, Campbell Island, var. *Novae Zelandiae* Skottsberg (syn. *A. minima* Col.). North Island, South Island. "Lamina squamosa, ut in *A. lineari* typica sed lana destituta."

2. *A. subulata* (Hook. f.) Cheeseman, *Manual,* ed. 2, p. 314. Stewart Island, Auckland Islands, Campbell Island.

Euastelia: Sect. Desmoneuron.

3. *A. Solanderi* A. Cunn. (syn. *A. Cunninghamii* Hook. f. Cheeseman, *Manual,* ed. 2, p. 315. "Kirk's *Hookeriana* was described in 1871 (*Trans. N.Z. Inst.,* 4, p. 244) and the locality given as Little Barrier Island. . . . I cannot distinguish more than one type of '*Cunninghamii.*' excluding *A. trinervia.*" North and South Islands.

4. *A. trinervia* Kirk. Cheeseman, *Manual,* ed. 2, p. 316—excl. descr. ovarii! Kirk and Cheeseman describe the ovary as 3-celled, and the seeds as sharply angled. "The specimens named *A. trinervia* first examined by me were those collected by Du Rietz under n. 2821, and he assured me that they undoubtedly belonged to *A. trinervia* of New Zealand botanists . . . ovary and berry were one-celled and the seeds terete. I examined Kirk's type: it agreed with Du Rietz n. 2821."

Asteliopsis: Sect. Isoneuron.

5. *A. Banksii* A. Cunn. Cheeseman, *Manual,* ed. 2, p. 315. North Island, South Island (Westport).

Tricella.

6. *A. nervosa* Banks et Sol. ex Hook. f. Cheeseman, *Manual,* ed. 2, p. 317. (Syn. *A. grandis* Hook. f., *A. nervosa* var. *grandis* (Hook. f.) Ckn. et Allan). North Island, South Island. "A very striking form, seen in cultivation at Kew, where it retains its large size and very broad leaves with their coloured costae. Kirk, who also knew the smaller, narrow-leaved variety well, had no possibility to get acquainted with Banks and Solander's *nervosa* . . . but both the description and the fine coloured plate prove beyond doubt that Solander's *A. nervosa* is identical with the plant called *A. grandis* by Hooker and Kirk."

var. *silvestris* Cockayne et Allan. Narrow-leaved, with less robust scapes. North Island, South Island.

var. *chathamica* Skottsberg. Chatham Islands. "The leaves of var. *chathamica* are as in *nervosa*, and of the same width as in var. *silvestris*. Racemes and flowers are also about the same, but the flower tube appears to be short and the segments narrower, the berry seems to be larger, with large seeds."

7. *A. Cockaynei* Cheeseman, *Manual*, ed. 2, p. 318. North Island, South Island, Stewart Island. "From a note by Cockayne and Allan it appears that this species consists of 'a good many geographical jordanons' and that 'some of these may ultimately be dealt with as separate species.' No such conclusions could be drawn from the dried plants available to me for examination."

8. *A. Petriei* Cockayne. Cheeseman, *Manual*, ed. 2, p. 318. South Island. "Berry conical-ellipsoid, probably yellow and sprinkled with purple, 10 mm. long including style of 1·5 mm., and 4·5 mm. across. Seeds about 15, ovoid-ellipsoid, subterete; long. max. 2·8, min. 2·1, med. 2·4 mm.; lat. med. 1·4 mm. (7 measured)."

9. *A. nivicola* Cockayne ex Cheeseman, *Manual*, ed. 2, p. 319. South Island. "Seems to come very near *A. psychrocharis*, Australia, and they are perhaps not specifically distinct."

Collospermum.

1. *C. hastatum* (Colenso) Skottsberg. (Syn. *Astelia Solandri* Hook. *f.*, Cheeseman, etc., *non* A. Cunningham; *A. hastata* Col.). Cheeseman, *Manual*, ed. 2, p. 316. North Island, South Island. "The binomial *Astelia Soland(e)ri* A. Cunn., misinterpreted by J. D. Hooker and taken up for *A. furfuracea* Banks et Sol. mscr., belongs, as I have shown, to a very different species, called *A. Cunninghamii* by Hooker. . . . The next name is *A. hastata* Colenso. I have examined the type specimens, both ♂ and ♀, and found them absolutely identical with *A. furfuracea* (only ♀) and with the specimens labelled *A. Solandri* by Hooker, Kirk, Cheeseman, etc."

2. *C. spicatum* (Colenso) Skottsberg. (Syn. *Astelia spicata* Col. in *Trans. N.Z. Inst.*, 14, 1882, p. 335; *A. nana* Carse in *Trans. N.Z. Inst.*, 57, 1926, p. 91). Whangarei, Hen Island, Franklin, Ruahine Mountains. "A miniature *hastatum*, looking like prematurely flowering seedlings of this. The inflorescence is not homologous with the terminal raceme of other species but with an entire panicle; a few large spathes are developed, but their axillary racemes are reduced to a solitary flower or even altogether abortive. The flowers are much smaller than in *C. hastatum*, ♂ being half as large only; in ♀ the difference is not so great."

3. *C. microspermum* (Colenso pro parte) Skottsberg. (Syn. *Astelia microspermum* (sic!) Colenso pro parte). Cheeseman, *Manual*, ed. 2, p. 317 (as syn. of *A. Solandri*"). North Island. "Colenso's description was based on a specimen now at Kew . . . Colenso's *Astelia microsperma* is a mixture of two species, collected on different occasions, probably by different persons. The description refers to both, but mainly to the ♀ raceme in the envelope which, contrary to the scape on the sheet, is in fruit, all flowers having

produced mature seeds, and it is from the seeds that the specific name *microspermum* was chosen. Evidently this name belongs to the fruiting piece and cannot be applied to Hooker's *A. Solandri.*"

REMARKS ON HYBRIDS.

A. Cockaynei × *nervosa.* "I have seen at least one intermediate form: South Island, Arthur's Valley 250 m., river valley, Feb. 21, 1914, R. Endlich m. 91 (♀ B). Leaves about 120 cm. long and to 3 cm. wide, pubescent as in *A. Cockaynei,* with simple costae. Scape only 20-22 cm. long. Panicle 12-13 cm.; largest spathe 30 x 2 cm.; bracts 6 x 2 mm. In fruit; seeds 6-9, long. max. 4·1, min. 3·2, med. 3·55 mm.; lat. med. 2·15 mm. (22 measured). Table 8 shows that the seeds are slightly smaller than in *A. nervosa* and larger than in var. *silvestris* or in *A. Cockaynei,* but the material is probably too small for a definite judgment."

"Cockayne and Allan (*Ann. Bot.,* 48, 1934, p. 17) mention a hybrid *Astelia Cunninghamii* Hook. fil. × *Solandri* 'A. Cunn.' (= Hook. fil. *non* A. Cunn.), acc. to the nomenclature used here = *Astelia Solanderi* A. Cunn. × *Collospermum hastatum* Skottsb. but they do not describe it. It is difficult to imagine what such a monster would look like; the supposed parents differ too much from each other, one would think, f.i. also in venation, syntepaly, and placentation. It lies nearer at hand to look for the *Astelia* component in subg. *Tricella* than in subg. *Euastelia.* So far there is nothing in the structure of *C. microspermum* that entitles us to regard it as a hybrid, but it needs further study."

SYNOPSIS OF SUBGENERA AND SECTIONS.

Astelia.

1. Subgen. I. *Euastelia* Skottsberg: Ovarium uniloculare placentis parietalibus. Semina teretia vel subteretia, funiculo conspicuo, incrassato.

A. Tepala omnino libera.

Sect. 1. *Palaeastelia* Skottsberg: Majuscula, foliis eximie tricostatis. Inflorescentia longe scaposa, ampla. Pistillodium maximum. Semina numerosa, parva irregulariter pyriformia, funiculo incurvo.

Réunion —1: *hemichrysa.*

Sect. 2. *Asteliella* Skottsberg: Parvae usque minimae, caespitosae usque dense pulvinatae. Folia ± distincte tricostata (vel nervis plurimis subaequlibus percursa), vel vagina excepta enervia. Inflorescentia ± reducta racemis paucifloris, usque uniflora. Flos ♀ conspicue major. Pistillodium magnum. Bacca pro magnitudine florum majuscula. Semina numerosa, parva, obovoidea-ellipsoidea. funiculo incurvo.

Tasmania—Australia .... 1: *alpina.*
New Guinea ..... 1: *papuana.*
New Zealand—Subantarctic Islands—
2: *linearis, subulata.*

B. Tepala breviter coalita.

Sect. 3. *Desmoneuron* Skottsberg: Majusculae, caespitosa. Folia nervis lateralibus nonnullis incrassatis subaequalibus percursa, ap-

proximatis, vel costam latiusculam formantibus. Tepala ima basi coalita. Pistillodium parvum conicum. Semina pyriformia-obovoidea, interdum leviter curvata, funiculo flabellato-incrassato.

Society Islands ..... 1: *Nadeaudii.*
New Zealand ..... 2: *Solanderi, trinervia.*

2. Subgen. II. *Asteliopsis* Skottsb.: Ovarium triloculare placentis centralibus. Tepala breviter coalita sed tubum companulatum baccam inferne arcte includenten nom formantia. Semina rotundato-angulata, funiculo haud conspicuo.

A. Majusculae, caespitosae haud pulvinatae. Lamina longe linearis, plano-canaiata. Inflorescentia ampla, pluriramea.

Sect. 4: *Periastelia* Skottsberg: Nervorum lateralium utroque latere mediana unus incrassatus. Pistillodium sat magnum, lageniforme. Bacca aurantiaca.

Rapa Island ..... 1: *rapensis.*
Marquesas Islands ..... 2: *tovii.*
Hawaiian Islands ..... 6: *Menziesiana, Forbesii, veratroides, argyrocoma, Degeneri, Waialealae.*

Sect. 5. *Isoneuron* Skottsberg: Nervorum lateralium plurimi subaequaliter incrassati. Pistillodium parvum ovoideo-conicum, Bacca ovoidea, purpurascens, glauca.

New Caledonia ..... 1: *neocalidonica.*
New Zealand ..... 1: *Banksii.*

B. Parva dense pulvinata. Lamina rigida lineari-triangularis, versus apicem profunde et anguste canaliculata. Inflorescentia pauciflora.

Sect. 6. *Micrastelia* Skottsberg: Folia apice duro sugpungente. Pistillodium sat parvum, conicum. Semina parva ovoidea, convexo-applanata et obtuse anguloso.

Temperate Andine South America, Falkland Islands—
1: *pumila.*

3. Subgen. III. *Tricella* (F. v. Muell.) Skottsberg.

Sect. 7. *Tricella* Skottsberg: Ovarium triloculare placentis axilibus pilis tubiformibus haud vel parum evolutis. Tepala inferne connata, in ♀ tubum conspicuum coloratum urceolatum baccam amplectentem formantia. Semina pauca majuscula, ellipsoidea-ovoidea teretia vel in ventro ± anguloso, valde lucida, funiculo parum incrassato. Majusculae latifoliae caespitosae usque minores subpulvinatae, semper terrestres. Folia plerumque eximie tricostata. Pistillodium sat magnum lageniforme.

Australia ..... 2: *psychrocharis, nervosa* var.
New Zealand ..... 4: *nervosa, Cockaynei, Petriei, nivicola.*

Collospermum.

Dioicum. Flos. ♂ quam ♀ valde major, cupula parva campanulata, lobis perlongis anguste linearibus vel lineari-ovatis reflexis tenuissimis. Stamina anthera lineari-hastata, tota longitudine filamento defixa, immobili, persistente. Flos. ♀ tubo hemisphaerico

ovarium includente, lobis lineari-triangularibus reflexis ± recurvis subaequalibus. Ovarium troculare, placentis e dissepimentis ortis. Stylus sat distinctus. Stigmata majuscula. Bacca carnosa. Semina parva nigra plerumque opaca ± irregulariter sulcata, tegumento gelatinoso e pilis perlongis crassis e funiculo ortis omnino cincta. Species epiphyticae, habitu nec non pubescentia Asteliae sat similes, caespitosae. Racemi densiflori semper simplices.

Fiji Islands ..... 1: *montanum.*
Samoa ..... 1: *samoense.*
New Zealand ..... 3: *hastatum, microspermum, spicatum.*

RECENT RESEARCHES.

For those who believe that the now ice-covered and utterly barren Antarctic continent once played a prominent role in the history of Austral floras there are few genera that reflect this history better than *Astelia.* In 1934 the author tried to monograph Astelia ("Studies in the Genus *Astelia* Banks et Solander," Kungl. *Svenska Vetenskapsakademiens Handb.*, 3 ser., T. 14: 2; from which the above material is taken). "*A. Solandri*" of J. D. Hooker (not of A. Cunningham) was made the type of a separate genus *Collospermum,* and became *C. hastatum* (Col.); the genus including two other New Zealand species, *C. montanum* from Fiji, and a closely related species from Samoa. *Astelia* in a restricted sense forms with *Milligania* from Tasmania and *Collospermum* a small natural group. Hairs in the shape of unistratose, multicellular, fringed scales are characteristic of this group, and reasons were advanced why Milligania should be considered to represent a more ancient type than the other two, as is indicated by the lower racemes bearing a few basal branches, the bisexual flowers, the dry and dehiscent fruits, and the naked seeds.

Astelia is tricentric; it occurs in the Neozelanic, the South American, and the African sectors. That the latter two possess only one species each does not make them less important, for each of these species forms a monotypical section and belongs to a different subgenus. Of the three subgenera, *Euastelia, Asteliopsis* and *Tricella,* the first has, according to my view, retained a greater number of ancient characters, and *Tricella* is more modified than *Asteliopsis.* For example, in *Euastelia* (excepting *Desmoneuron*) the tepals are free, in *Asteliopsis* united only basally, in *Tricella* formed into a distinct tube. So, too, the ovary in *Euastelia* is one-celled with parietal placentae, in the other two sub-genera three-celled with axial placentae. *Tricella,* also, has the most restricted range, while *Collospermum* shows, as it were, further development along the *Tricella* line.

The distribution of *Collospermum,* and even more so the existence of a special N. and E. Polynesian section, *Periastelia,* of *Asteliopsis,* brings *Astelia* into the small group of Antarctic genera that have a marked and wide-ranging extension into the Pacific. As is stated of *Periastelia* in my recent paper, "Antarctic Plants in Polynesia" (*Essays in Geobotany in Honor of William Albert Setchell,* University

of California Press, 1936, p. 294—with map reproduced here): "From its geographical position, it seems natural to look for its closest relatives in the south-western Pacific. But the Tahitian species belongs to a different subgenus. In New Caledonia and New Zealand we find members of the same subgenus, but they form another section not nearly related to *Periastelia*. We discover its nearest ally where we would not be likely to look for it, in the Magellanic *Micrastelia*. Simply because this occurs in America we are not entitled to classify the Hawaiian species as belonging to an 'American' element. *Micrastelia* is a stranger in the neotropical flora." My opinion that the ancient home of *Astelia* lay in the Antarctic seems fairly well founded, but remains hypothetical; it is an undeniable fact that its present headquarters are New Zealand. All three subgenera are represented there. Of *Euastelia*, sect. *Asteliella* will be mentioned below; sect. *Desmoneuron* has two species in New Zealand and one in the Society Islands (sec. *Palaeastelia* is endemic in Réunion). Of subgenus *Asteliopsis* sect. *Isoneuron* has one species in New Zealand and one in New Caledonia; sect. *Periastelia* is an outlying group known until quite recently only from Hawaii and Marquesas; sect. *Micrastelia* is confined to subantarctic America.

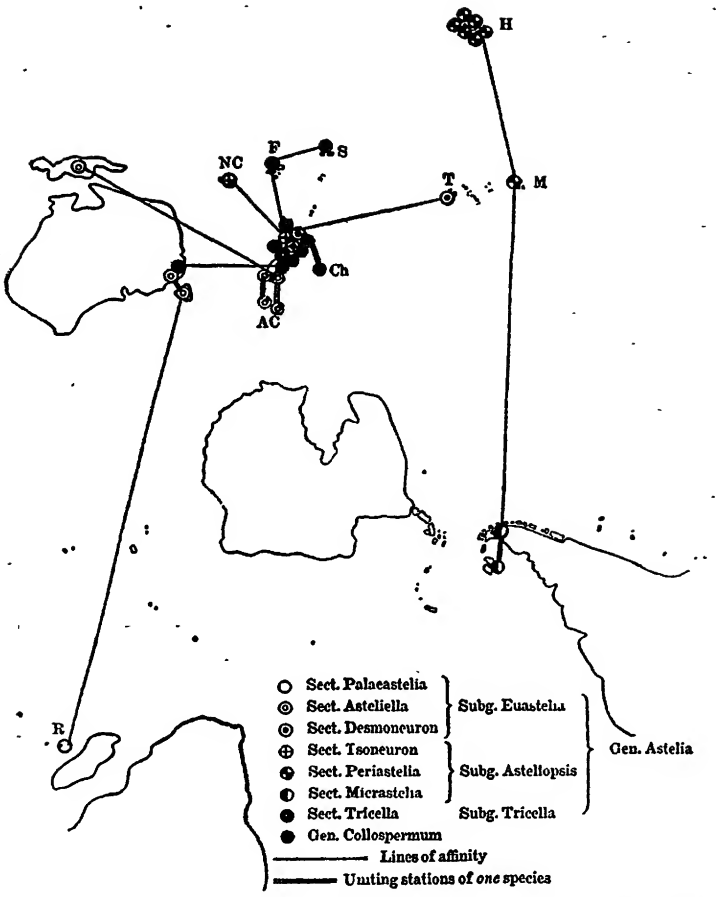
Evolution is illustrated in *Asteliella* along the road: Auckland—Campbell Islands—New Zealand—New Guinea, with the side branch—Tasmania—S.E. Australia. *A. linearis* Hook. fil. ranges over Auckland and Campbell Islands and New Zealand, *A. alpina* R. Br. over Tasmania and the high mountains of New South Wales and Victoria, *A. papuana* Skottsb. is endemic to New Guinea, and is the only species found there. This is a poor support for Miss Gibb's theory that the Antarctic flora is Papuan. It is interesting to observe that *A. papuana* stands nearer to *linearis* than to *alpina*, while it is important that the Subantarctic Islands possess their special species—*A. subulata* (Hook. fil.) Cheeseman—which occupies an isolated position among the *Asteliellas* and altogether so in *Astelia*.

Australia as a station for *Astelia* is a dependency of New Zealand. *A. alpina* is, of course, a good species, but close to *linearis* and *papuana*. *A. psychrocharis* F. v. M. (subg. *Tricella*), long confused with *alpina*, came so close to *A. nivicola* Ckn. from New Zealand that the segregation of two species requires to be supported by more ample material than is available at present. The recent discovery in South Victoria by J. H. Willis of a variety of *A. nervosa* further strengthens the opinion expressed above of the relations between Australia and New Zealand.

No direct line leads from the New Zealand centre of *Astelia* to north and east Polynesia, where subg. *Asteliopsis*, barely represented in New Zealand, has reached a considerable degree of differentiation in the endemic section *Periastelia*. The difference between this and sect. *Isoneuron* is profound, and in spite of the very great dissimilarity in habit, the affinity between *Periastelia* and *Micrastelia* is more in evidence. This is especially well seen in the leaf-venation, the staminodes, and the seeds.

Between the New Zealand-Australian region and Hawaii-Marquesas only two stations for *Astelia* were known until very recently, New Caledonia and the Society Islands, and their species do not help us to understand *Astelia* in Hawaii. In Samoa and Fiji we find *Collospermum* only, not *Astelia*. There remained, however, one high volcanic island in Polynesia not well explored: Rapa. I expected an *Astelia* from there, and it was discovered by the Bishop Museum expedition from Honolulu in 1934. It proved to be an undescribed species, which I have called *A. rapensis*. A look at the map shows that we had a right to expect a species related to *A. Nadeaudii* of Tahiti and Rariatea, a *Desmoneuron*, but *A. rapensis* is a true *Periastelia*. Its position becomes less surprising if we remember that there are other instances where a special line of affinity Hawaii-Marquesas has been established. The distance between Nukuhiva and Rapa is twice as great as between Rapa and Tahiti, but not very imposing as compared with the distance between Hawaii and Marquesas. We have little reason to discuss these occurrences as a result of direct migration. The species in question, *A. tovii* and *A. rapensis*, are not very close; the former stands much closer to the Hawaiian species. *A. rapensis* lessens the spatial distance between *Periastelia* and *Micrastelia*, the degree of affinity between which I have mentioned.

I have summed up the situation as follows, in my monograph: "Few genera are tricentric and eu-circumpolar, most are bicentric and not found in the South African sector. Two important genera agree with *Astelia*: *Gunnera* and *Acaena*. Both are tricentric, both reach north as far as Hawaii; *Gunnera* is also found in the tropical Andes, Uruguay and East Africa, *Acaena* in California. Roughly, the type of distribution is the same in all cases. It bears witness of an original home in the Antarctic regions, of an old Tertiary centre, of expansion, differentiation, dislocation and isolation, resulting in endemic subgenera, sections, species and varieties. *Astelia* radiated from Antarctica. It is difficult to understand the present range of its several constituents and their mutual relations unless we can assume that regions now widely separated from each other and from Antarctica were, some time during the Tertiary, in 'floristic contact' by way of Antarctica. . . . If it is true that Palaeantarctica was the birthplace of the *Astelia* assemblage, it is also true that New Zealand is its present headquarters. All three subgenera of *Astelia* are represented there, and only *Asteliopsis* has its centre elsewhere. *Tricella* is almost restricted to New Zealand. Of the seven sections, four are found in New Zealand, but none of them is endemic there. Finally, New Zealand is the only place where *Astelia* and *Collospermum* occur together. It has long been the centre of the group and it was the most important scene of its later history."



AC—Auckland and Campbell Islands. Ch—Chatham (Warikauri) Island. F—Fiji Islands. H—Hawaiian Islands. M—Marquesas Islands NC—New Caledonia. R—Réunion. S—Samoa. T—Society Islands.

FIG. 1.—Distribution of *Astelia* and *Collospermum*.